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Bone Augmentation for Implants: A Restorative Dentists Planning Guide

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Background

The restorative dentist sometimes faces clinical situations where bony defects left by trauma, infection, or resorptive patterns compromise the prosthetic treatment plan. For some situations, implants are rapidly becoming a standard of care. When planned by the restorative dentist in an ideal location, restorations anchored by endosteal implant fixtures can offer excellent form, function, and esthetics. In the past, implants were placed wherever there was adequate available bone, and the final restoration was sometimes compromised. Today, surgeons can place bone where the restorative treatment plan indicates the implants should be placed.

There are two major alternatives for placing bone in defect areas:

1. Although allografts (such as Decalcified Freeze Dried Bone [DFDBA] with or without the use of membranes like Gore-Tex®) can be used, they are limited in the amount of bone that can reliably be achieved, especially in areas with flat contours. These are indicated for smaller, cup-shaped defects where the surrounding bony walls can support the particles of the graft. Titanium reinforced membranes can “tent” over the graft and produce more volume in situations where the defect is limited. Clinical experience has shown that the bone resulting from this type of graft may not be as dense as block autografts, although the clinical significance of this observation is not known.

2. Autogenous bone grafts are the gold standard for repair of alveolar defects.(1) These are categorized as particulate or block grafts. We will address block grafts here, where a block of bone is taken from one site and fixed to a recipient site with titanium screws.

The type and quality of bone present is a factor in implant success. Lekholm and Zarb’s classification for bone type (2) is:

Type 1 is homogenous, compact bone

Type 2 is a thick layer of compact bone surrounding a core of dense trabecular bone

Type 3 is a thin layer of cortical bone surrounds a core of dense trabecular bone of good strength.

Type 4 represents a thin layer of cortical bone surrounds a core of low density bone

The most favorable for implant success are Types 2 and 3. Cancellous bone is sometimes useful in filling gaps between the donor block and site bed, so sites where cancellous bone can also be harvested will be discussed.

The soft tissue in the recipient site is important for two reasons. First, the soft tissue profile after augmentation is critical

to the esthetic appearance of an implant-supported prosthesis. Second, there must be enough soft tissue to cover a block graft or membrane primarily, without flap tension or perforation. To gain an adequate amount, you may want to do a soft tissue augmentation procedure first. The recipient site must be free of pathoses or foreign bodies, and at least 6 weeks post extraction.

Preoperative evaluation

It is critical that the restorative dentist formulates the restorative treatment plan first. A thorough examination with a panoramic radiograph, full mouth series of radiographs, and an articulated set of casts is the first step. Then a diagnostic wax-up of the planned restoration and proposed implant sites will help the surgeon determine the extent of additional bone needed, which will guide the choice of donor bone site. There are three primary choices for donor sites:

	Ramus	Symphysis	Iliac crest
Mesio-Distal quantity	2- 3 teeth	3-4 teeth	> 4 teeth
Bucco- Lingual quantity	< 4mm	4-6mm	> 6mm
Advantages	<ul style="list-style-type: none">• Fair to good access• Little esthetic concern• Minimal resorption	<ul style="list-style-type: none">• Usually good access• Can obtain cancellous bone• Minimal resorption	<ul style="list-style-type: none">• Large volume available• Osteogenic• Can obtain cancellous bone
Disadvantages	<ul style="list-style-type: none">• Possible damage to inferior alveolar bundle.• Grafts are generally thinner	<ul style="list-style-type: none">• Poss. Temporary dyesthesia• Possible ptosis of the chin• Possible pulpal damage to anterior teeth	<ul style="list-style-type: none">• Second, extraoral surgical site• Most graft resorption• Possible post-operative gait disturbance

Clinically, it has been observed that grafts from facial bones tend to resorb less than grafts from long bones such as the ilium (3). It is a common error to overestimate the amount of bone obtainable from intraoral donor sites. Extraoral sites must be considered when attempting to augment larger defects. Osseous grafting for alveolar ridge augmentation carries risk. The patient must be informed of the potential complications of bleeding, swelling, infection, dyesthesia, as well as a possibility for graft resorption or disunion.

Ramus grafts

Ramus blocks have the advantage of fair to good surgical access in an area with no esthetic concerns. Generally, a block of bone can be harvested that will span an edentulous area of two to three teeth. However, these blocks are usually thinner than their symphyseal counterparts and are best indicated in gaining horizontal ridge width (4). They also tend to heal with minimal resorption, usually resulting in type 1 bone (5). Contraindications include the presence of third molars, a high inferior alveolar nerve, prior history of temporomandibular dysfunction, a prominent external oblique ridge or the inability of the patient to open adequately.

When harvesting a ramus block, the surgeon needs to be aware of the location of the mandibular canal to avoid damage to these structures, therefore good quality radiographs are critical. The mandibular canal is usually located more to the lingual in the posterior region and more buccal toward the anterior. Even with proper surgical technique and preoperative planning, paresthesia may result, but it is usually transitory unless the inferior alveolar nerve is completely transected. There is also some risk of damage to the buccal nerve even though the harvest incision is made over the external oblique ridge. Overall, neurosensory changes in the ramus area are less noticeable to the patient than those occurring in the chin. Postoperatively, the donor site appears similar to extraction of a bone-impacted third molar.

Symphyseal blocks

The mandibular symphysis allows for good surgical access and permits the harvest of a thick (4-6mm) rectangular block of bone that can augment an edentulous area spanning three or four teeth. Up to 50% more volume of bone can be taken from the symphysis than from the ramus (6). A limited amount of cancellous bone that can be used to fill discrepancies between the block and the recipient site can also be harvested. These grafts tend to heal with minimal resorption and usually result in type 2 bone (5). The curved shape also makes this useful in restoring ridge form to the anterior maxilla.

Treatment planning for this area includes taking a lateral cephalometric radiograph. From this, the antero-posterior width of the graft can be estimated. It will also guide osteotomy preparation and help avoid the lingual symphyseal cortex. Potentially, the graft can extend from the inferior cortex of the mandible to 5 mm apical to the roots of the teeth, which minimizes post-operative paresthesia.

Dysethesia in the lip and a "wooden" sensation of the anterior teeth are common post-surgical complications (6). Both of these sequelae are often temporary, lasting from a few weeks to a several months. Some patients (15 - 25%) may experience lower incisors that no longer respond to endodontic diagnostic tests. Endodontic therapy may not be required unless there are other indications of pulpal pathosis, but patients must be made

aware of the risk of pulpal damage. Postoperative ptosis of the chin is a rare complication. It is possible to reenter the chin for additional bone harvesting at a later date; however, extraoral sites should be considered if larger bone volumes are required.

Iliac crest grafts

In cases where the volume of bone needed is greater than can be harvested intraorally, you may consider obtaining a graft from the iliac crest. Bone obtained from the hip has excellent osteogenic properties and both cortical and cancellous bone can be obtained. This graft site has long been used for mandibular reconstruction following radical resective surgery, and it is natural to apply this technique to alveolar ridge augmentation prior to implant placement. Iliac crest surgery is an operating room procedure that requires either a general or regional anesthetic; post operative pain and changes in gait are not uncommon, although usually temporary, are significant considerations.

Postoperative Planning

The timing of implant surgery is critical following autogenous bone grafting. Without functional stimulation, there is a tendency for grafted bone to resorb. Current thinking recommends fixture placement 4 to 5 months following grafting in maxillary sites (5). Mandibular sites should be reentered in 5 to 6 months. The somewhat longer healing period for mandibular graft sites may partly be due to the generally thicker cortex of the mandible compared to the maxilla, which may require greater time to integrate the bone graft (6). The graft should be monitored for evidence of resorption during healing. This is accomplished by gentle palpation of the grafted area. Often, graft fixation screw heads are detectable in blocks that undergo significant resorption. If this occurs, reentry into the site should be considered.

References

1. Rissold AR, Bennett J, Bone Grafting and its Essential Role in Implant Dentistry. *Dent Clin North Amer* Jan 1998; 42(1): 91-116.
2. Lekholm U, Zarb GA, Patient Selection and Preparation. *Tissue Integrated Prostheses - Osseointegration in Clinical Dentistry*. Chicago: Quintessence Publishing Co; 1985.
3. Smith JD, Abramson M. Membranous vs. Endochondrial bone autografts. *Arch Otolaryngol* 1974 Mar;99(3):203-5.
4. Misch CM, Ridge Augmentation using Mandibular Ramus Bone Grafts for the Placement of Dental Implants: Presentation of a Technique. *Regeneration Report* 1996 Mar;8(2):127-35.
5. Misch CM, Misch CE, Resnick RR, Ismail YH. Reconstruction of maxillary alveolar defects with mandibular symphysis grafts for dental implants: a preliminary procedural report. *Int J Oral Maxillofac Implants* 1992 Fall;7(3):360-6.
6. Misch CM. Comparison of intraoral donor site for onlay grafts prior to implant placement. *Int J Oral Maxillofac Implants* 1997 Nov-Dec;12(6):767-76.

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